Report Plexos Project

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- investment support
  One time financial support to cover part of the investment costs. The support is large enough to make the investment profitable. Some differences can be used for fine tuning, e.g. more support for wind power in areas with less wind.
  - advantages
    - possibility of finetuning
  - disadvantages
    - requires much capital at beginning
    - no incentive to roduce
    - limited security for investor
    - in case of fine tuning: much administration
- tendering
  Auction for a certain amount of capacity which shall be installed. Won by the offers requiring the lowest support. This initiative is also done as investment support, but with a tendering procedure. Providers are asked for support bids, the cheapest one gets the support.
  - advantages
    - competition between suppliers, therefore lower costs than investment support
  - disadvantages
    - same as investment support, but
    - less predictability
    - prone to corruption
- feed-in tariff
  A fixed price for feeded kWh is payed for a predefined period.
  - advantages
    - promotion of mid-term and long-term technologies
    - investment security for producer
  - disadvantages
    - possible risk of technology overfunding
- premium
  Like feed-in tariff, but instead of a fixed price an additional amount per kWh is paid to the producer.

- advantages
    - market based
- disadvantages
    - less certainty than feed-in tariff

- green certificates This is a nordic system for supporting renewables. Some amount of certified energy has to be bought from energy suppliers, otherwise they are penalized. The intention is to build as much renewables as possible in short time. From 2020 new renewables are not certified any more, so the possibility to get enough certified power decreases and the risk of getting penalized increases.
    - advantages
        - control of total amount of renewables
        - efficient market-based solution
    - disadvantages
        - less certainty than feed-in
        - complex
        - high administration costs

3 Analysis

3.1 MT Schedule

The medium term schedule is done for one year. Three different scenarios (low, normal, high inflow) to the reservoirs in Norway and Sweden are simulated. The different scenarios are described below.

3.1.1 normal inflow scenario

For this case a normal inflow scenario was chosen. The inflow accords to the average inflow in a year in Norway and Sweden.

optimal generation dispatch
The optimal generation dispatch for normal inflow for Germany can be seen in figure 1. The generation dispatch for swedish generation units can be seen in figure 2, the norwegian dispatch is shown in figure 3.

transmission
The transmission between the three countries Norway, Sweden and Germany is shown in figure 4. It is done not considering the flow direction, but the amount of power.

emission
The total emissions for all countries together can be seen in figure 5. The emissions can be interpreted in following way:

- Norway: Due to the fact that most power installed is done with renewables (hydro power, wind power) and only some small amount of gas power, there are hardly and CO_2-emissions in Norway.
- Sweden: Some renewable energy and a large amount of nuclear power lead to small CO_2-emissions.
- Germany: The biggest amount of the produced emissions are emitted from german power plants.

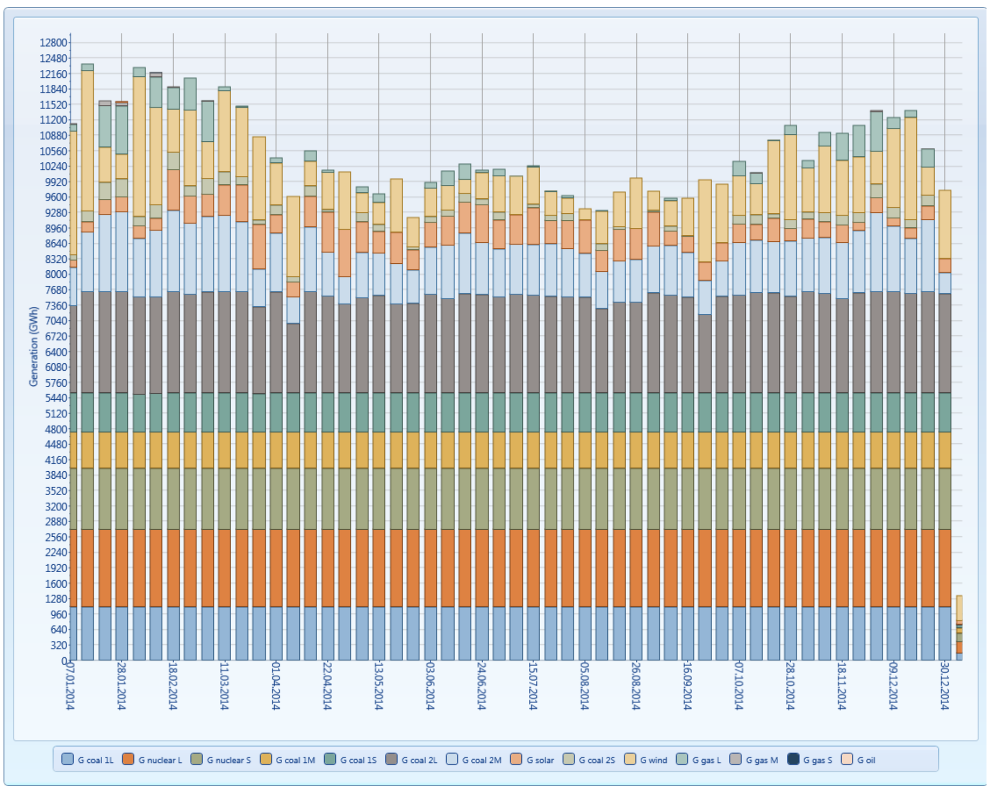

Figure 1: Optimal generation dispatch for Germany 2014 with normal inflow

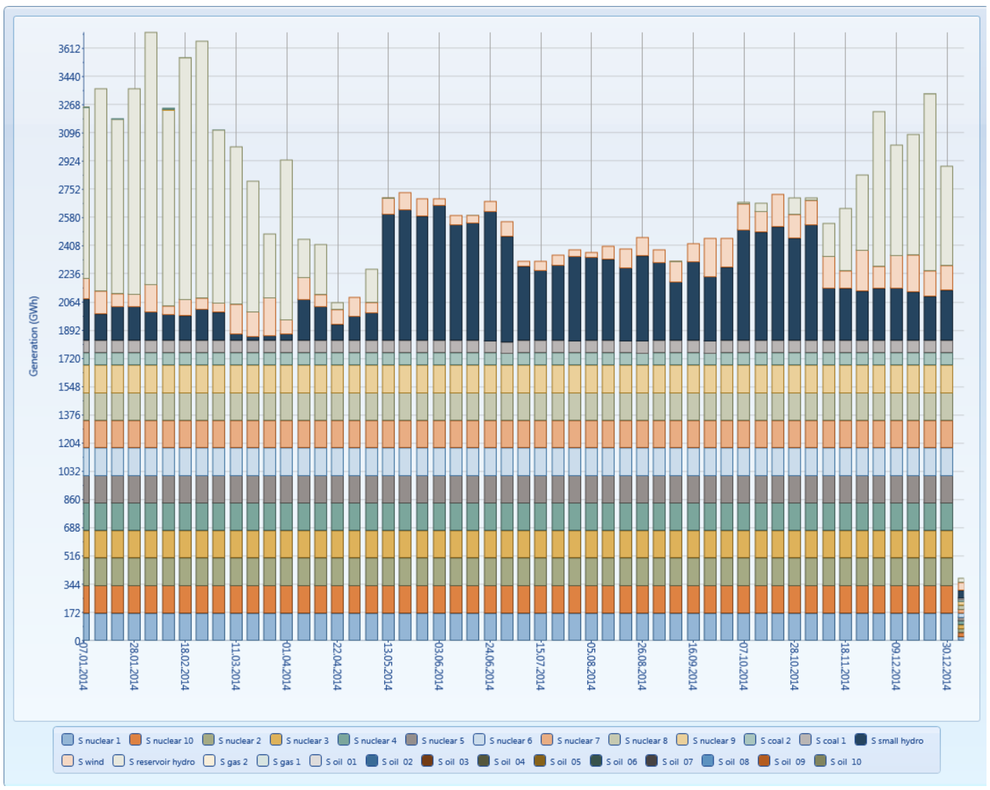

Figure 2: Optimal generation dispatch for Sweden 2014 with normal inflow

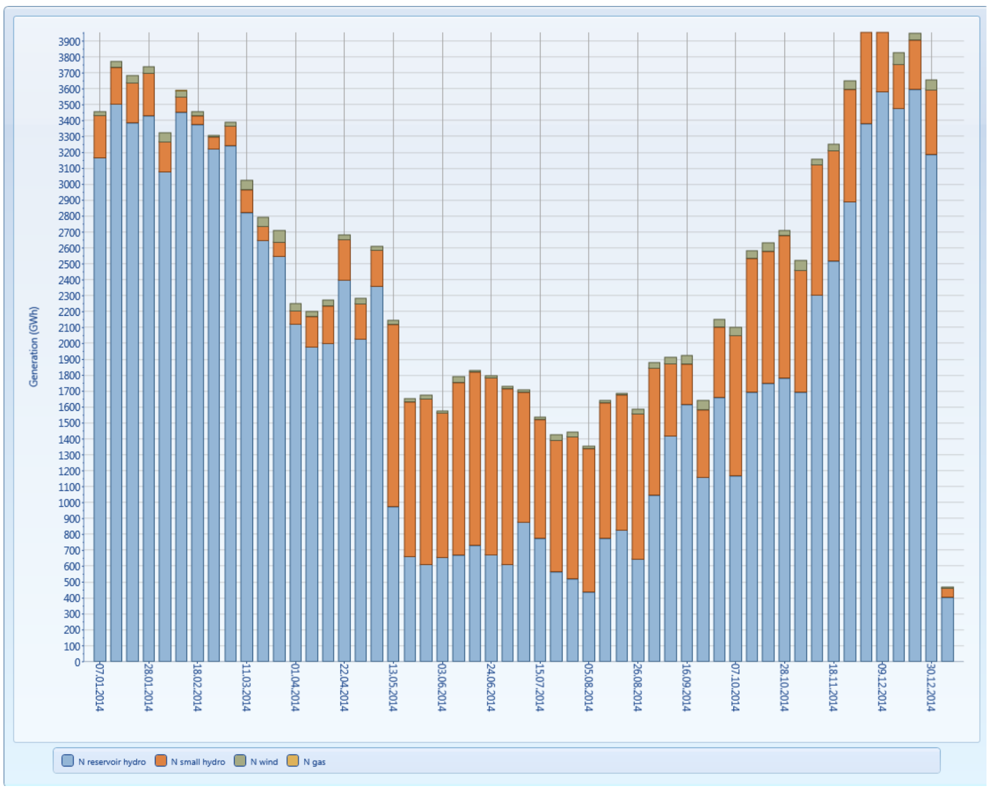

Figure 3: Optimal generation dispatch for Norway 2014 with normal inflow

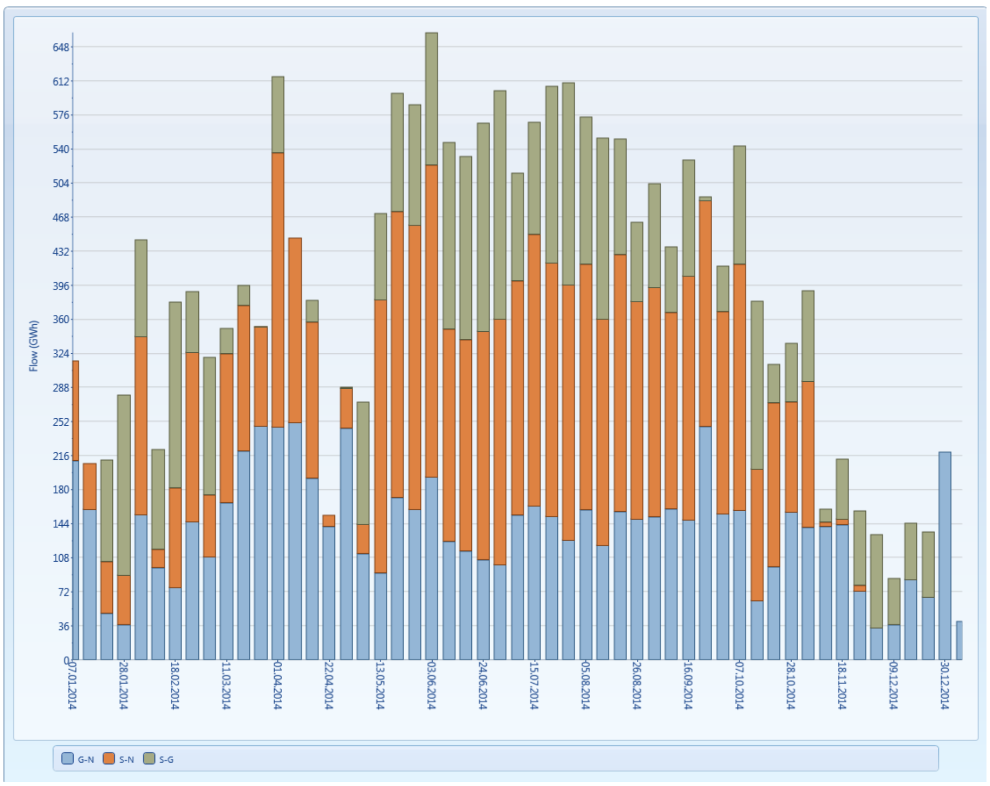

Figure 4: Transmission between N/W/S with normal inflow

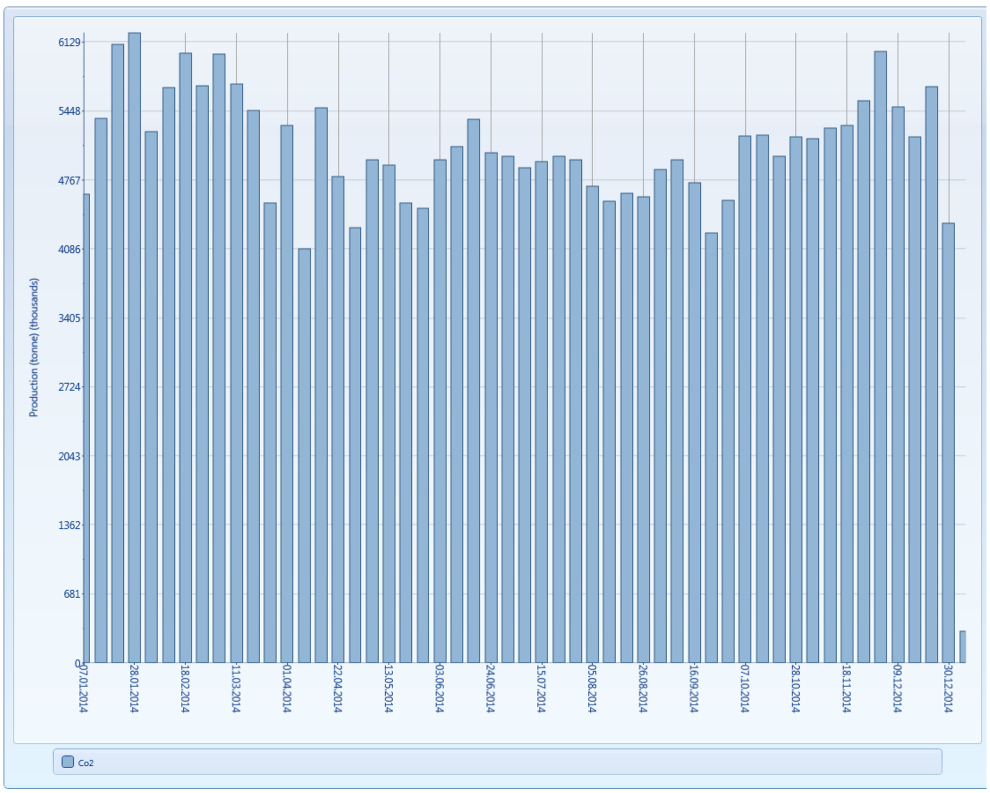

Figure 5: Total emissions for normal inflow 2014

price

Energy prices for the different weaks of 2014 for the analyzed countries are shown in figure 6.

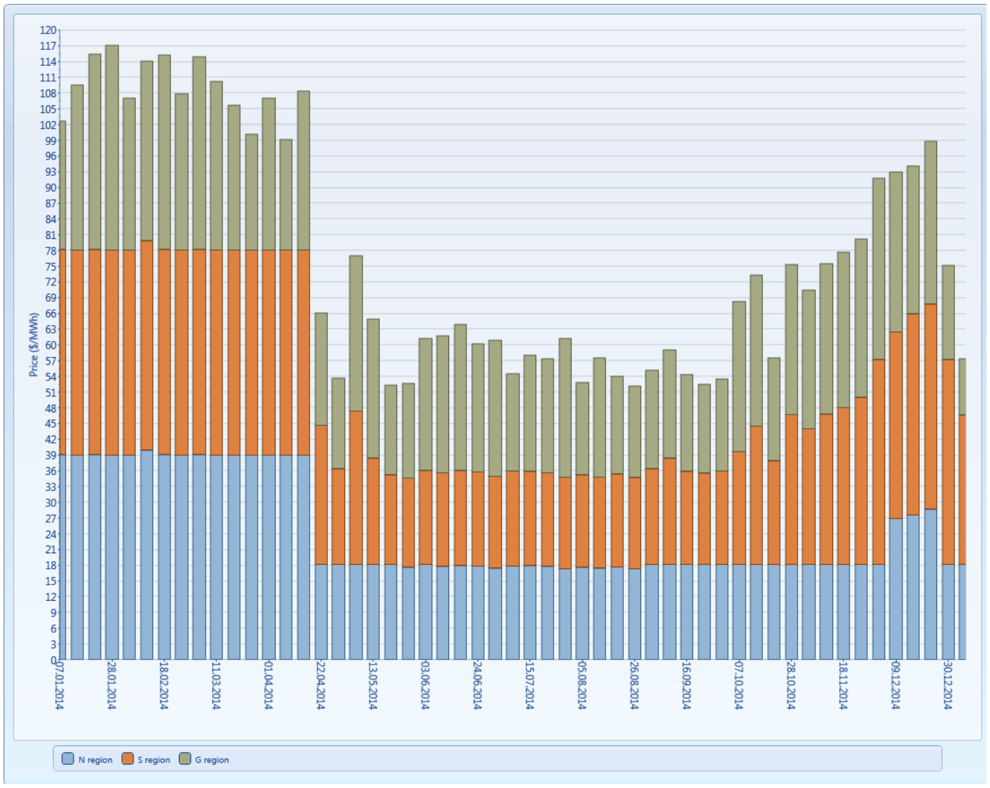

Figure 6: Calculcated prices with normal inflow

3.1.2 low inflow scenario

optimal generation dispatch

transmission

emission

price

3.1.3 high inflow scenario

optimal generation dispatch

transmission

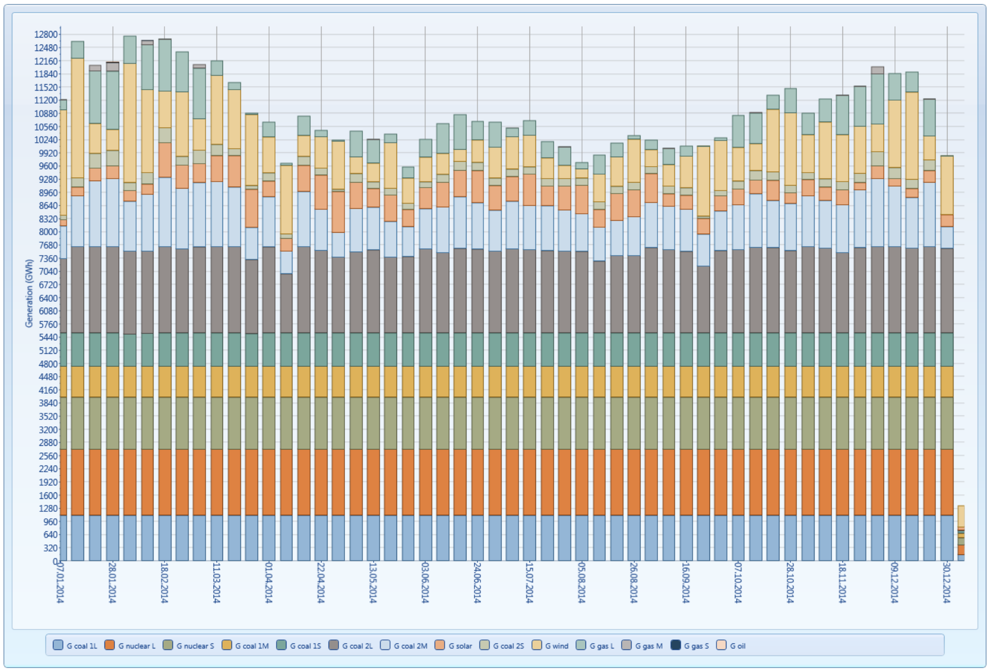

Figure 7: Optimal generation dispatch for Germany 2014 with low inflow

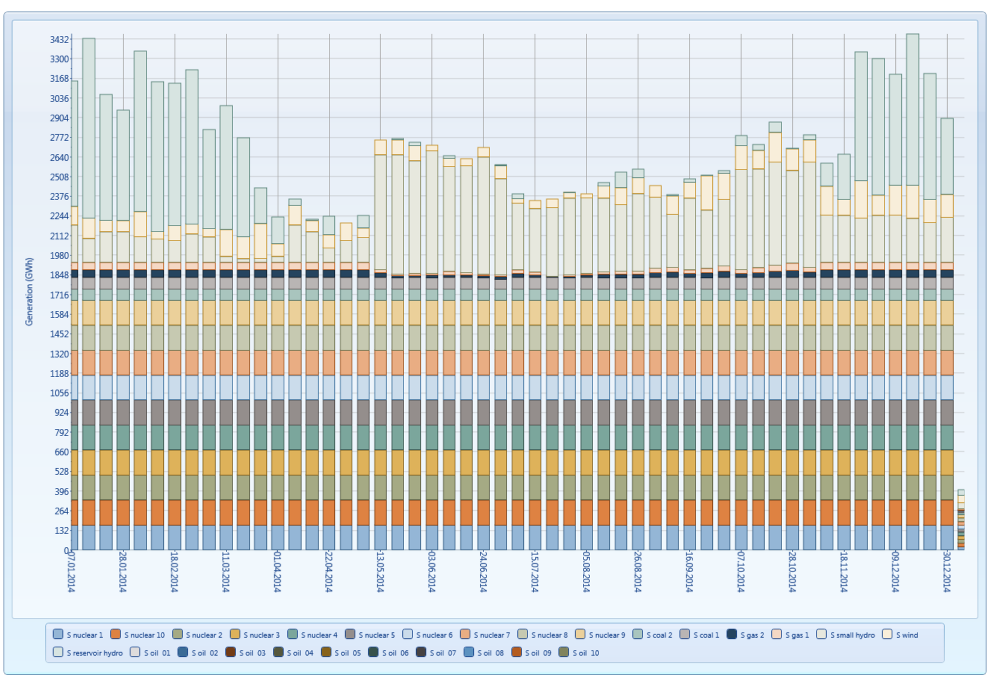

Figure 8: Optimal generation dispatch for Sweden 2014 with low inflow

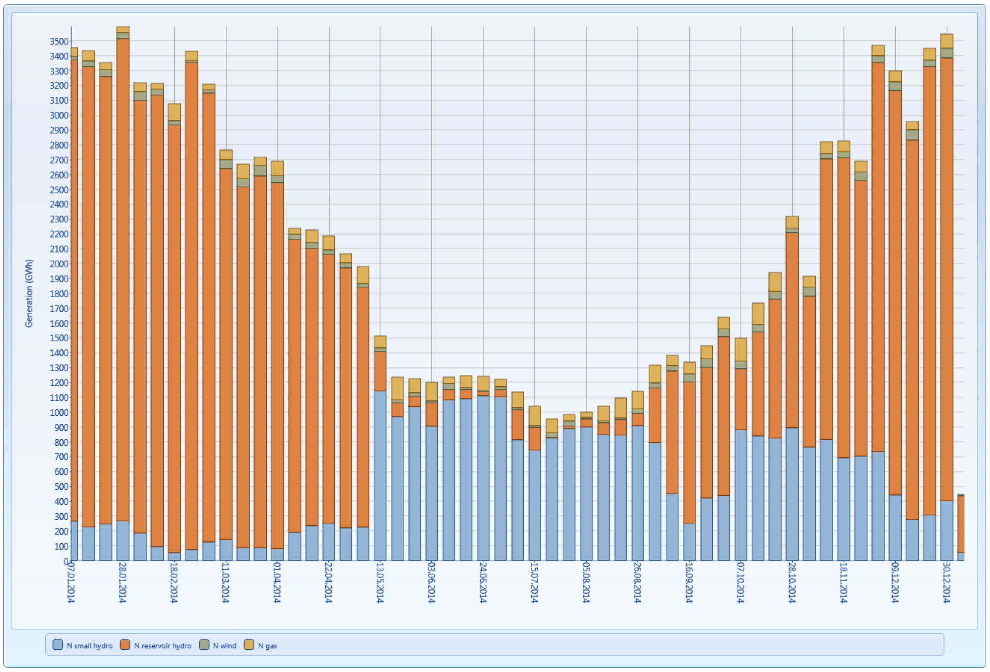

Figure 9: Optimal generation dispatch for Norway 2014 with low inflow

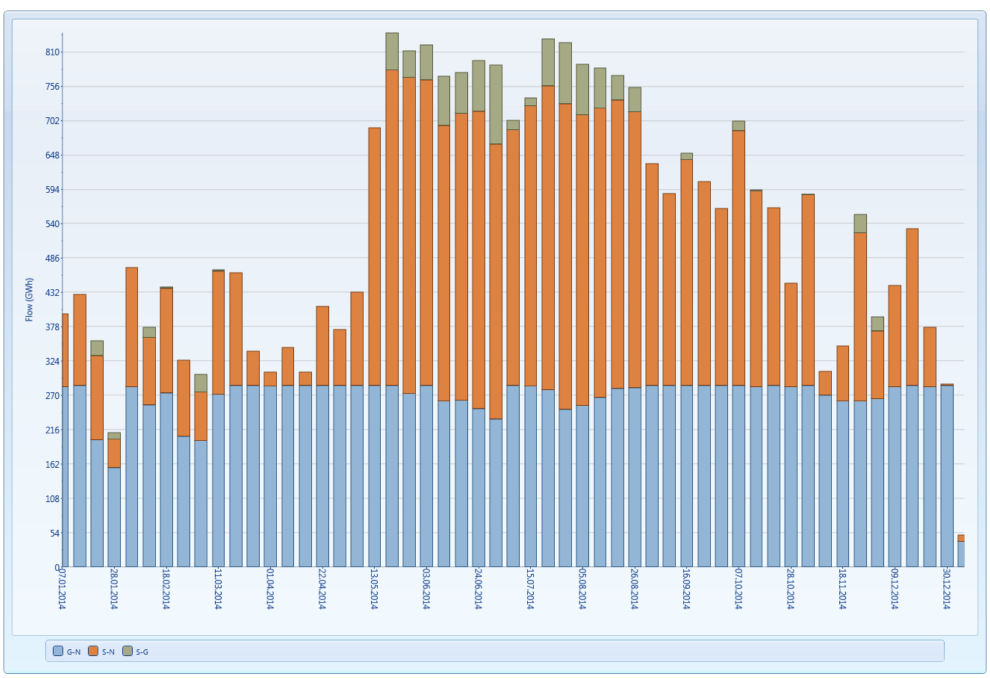

Figure 10: Transmission between N/W/S with low inflow

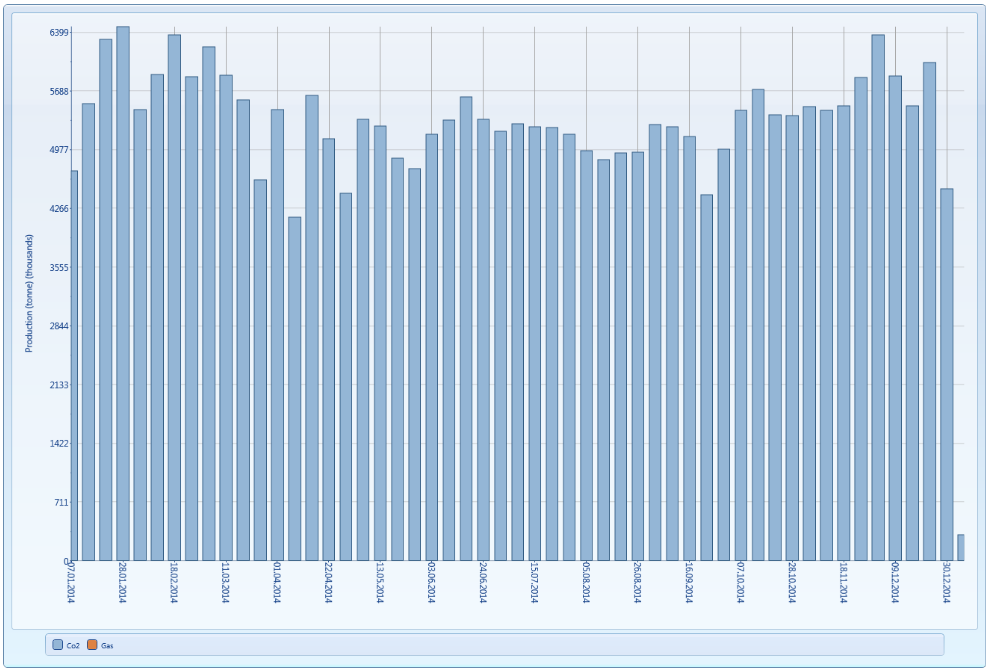

Figure 11: Total CO_2-emissions for low inflow 2014

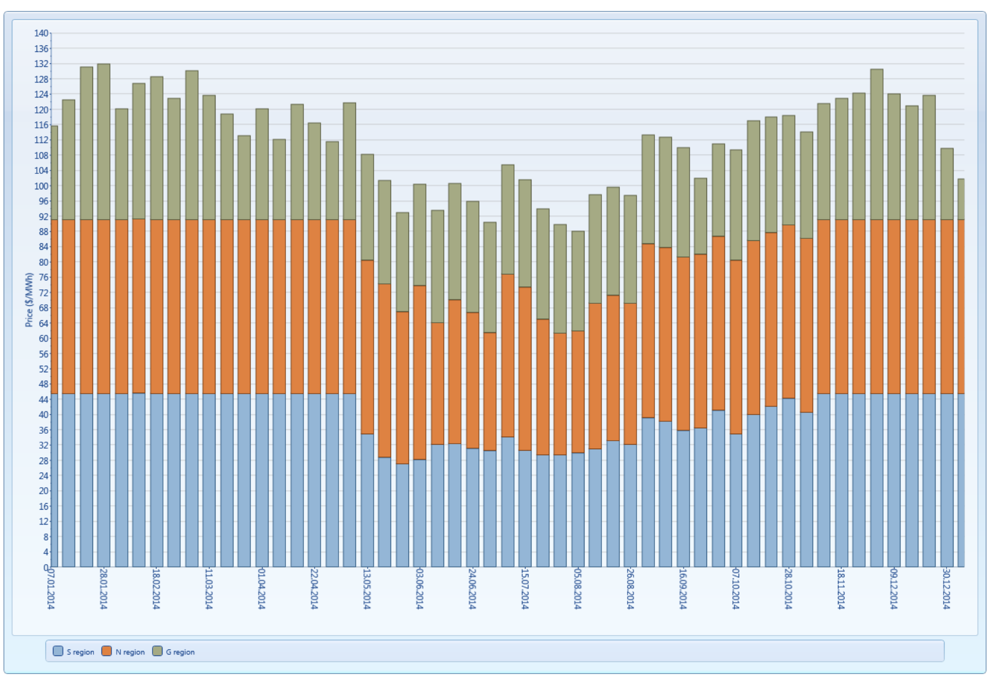

Figure 12: Calculcated prices with low inflow

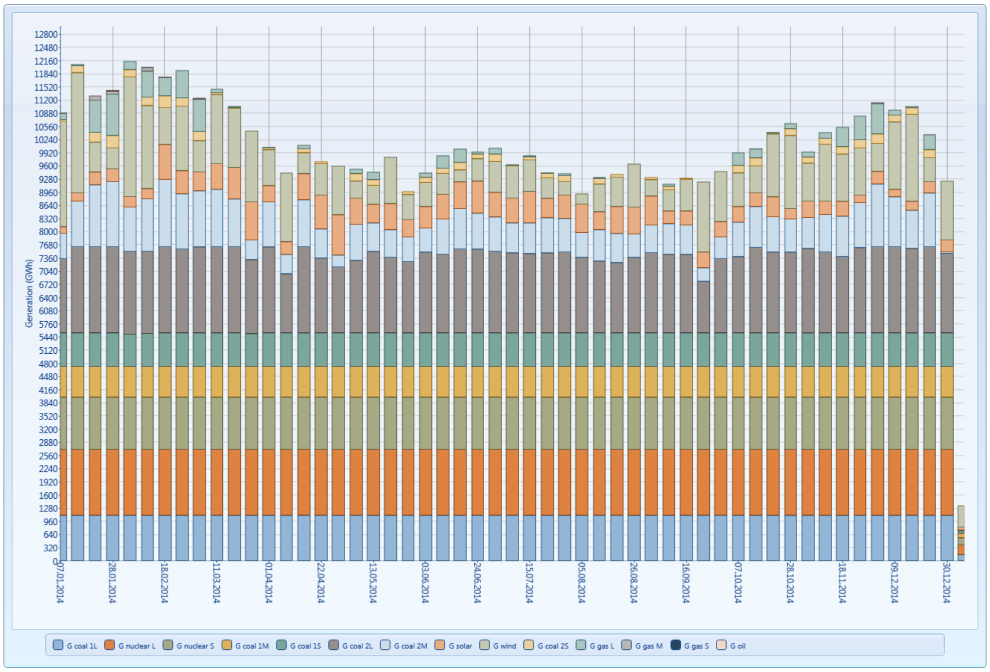

Figure 13: Optimal generation dispatch for Germany 2014 with high inflow

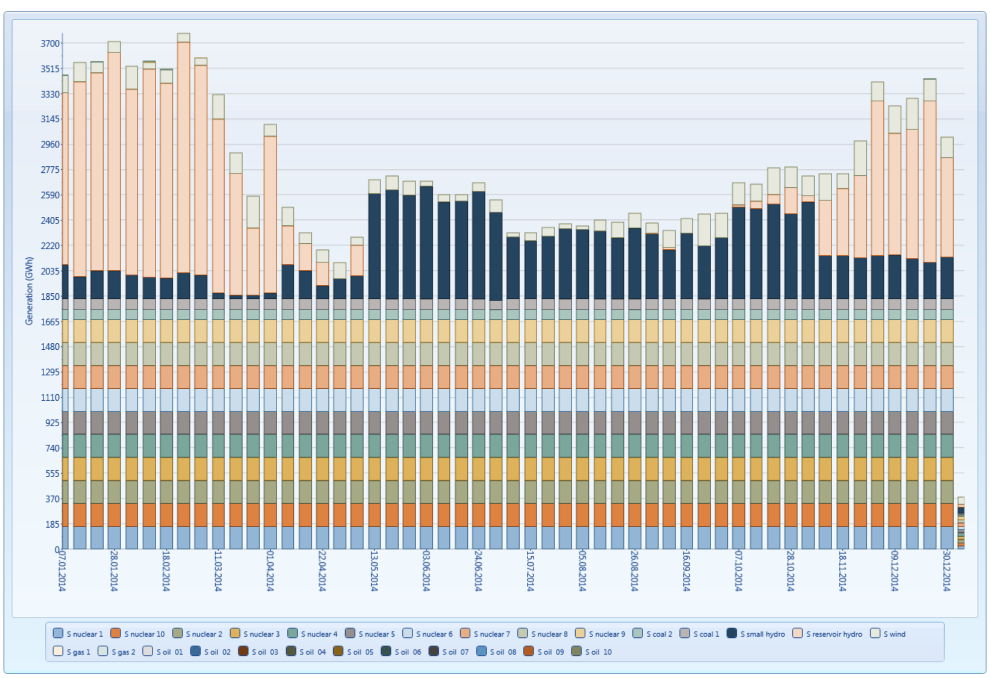

Figure 14: Optimal generation dispatch for Sweden 2014 with high inflow

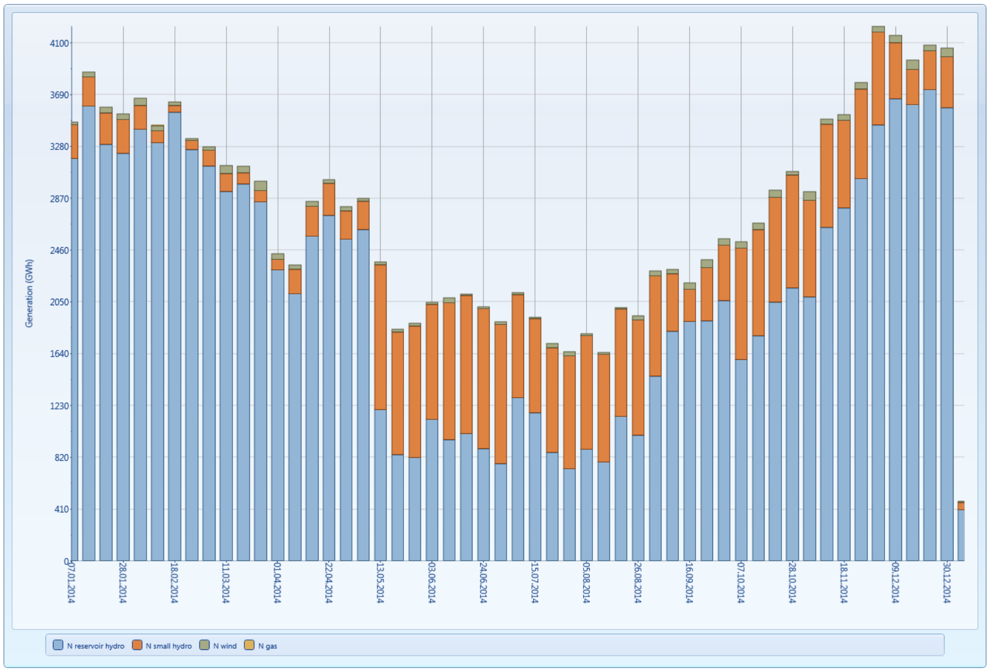

Figure 15: Optimal generation dispatch for Norway 2014 with high inflow

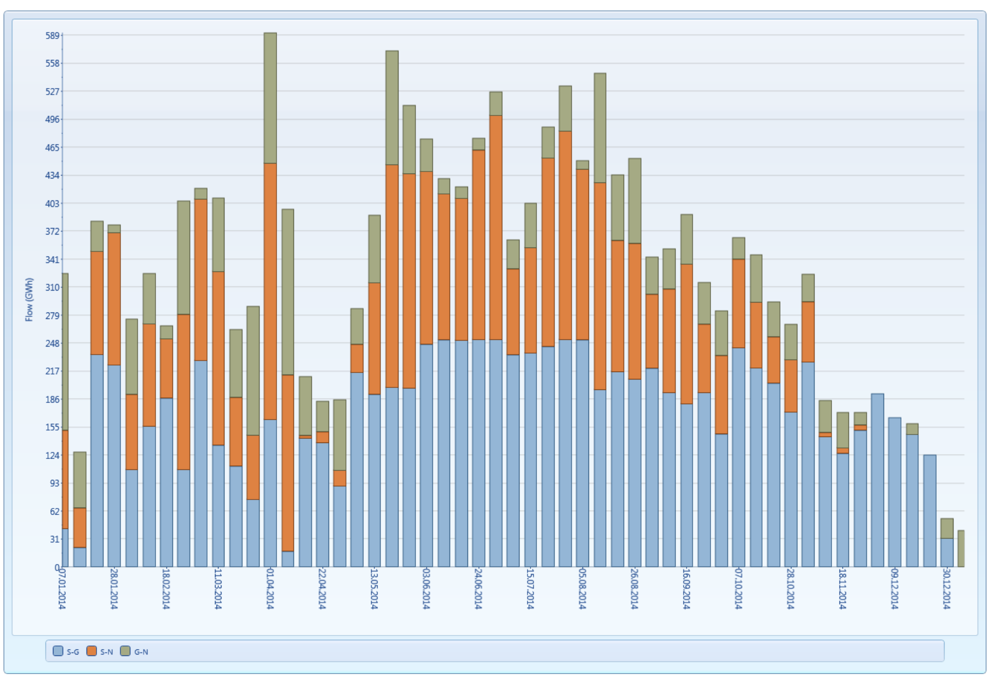

Figure 16: Transmission between N/W/S with high inflow

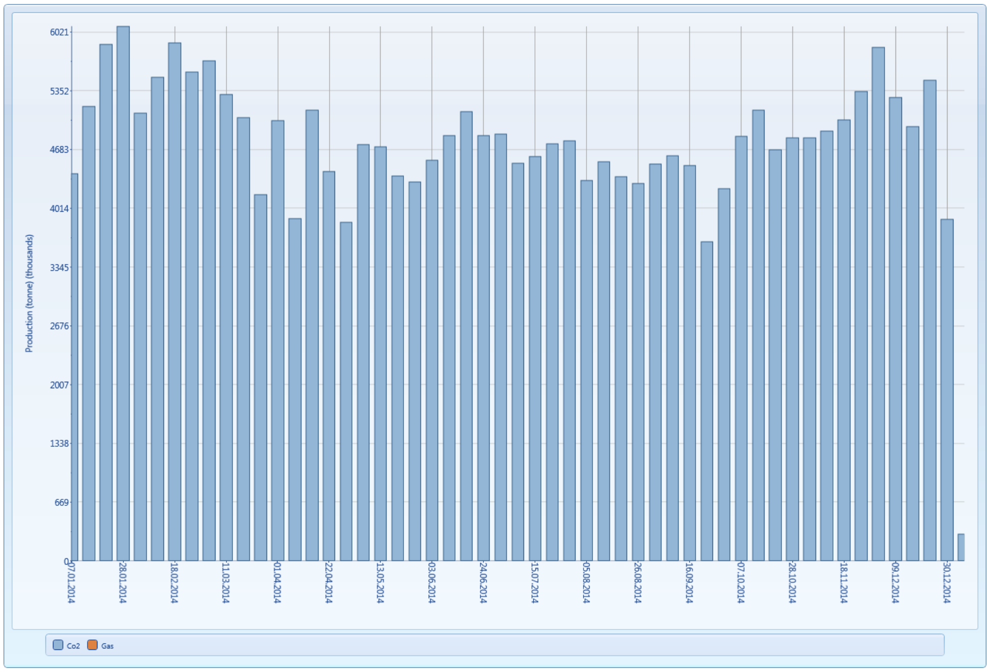

Figure 17: Total CO_2-emissions for high inflow 2014

emission

price

3.2 Expansion planning

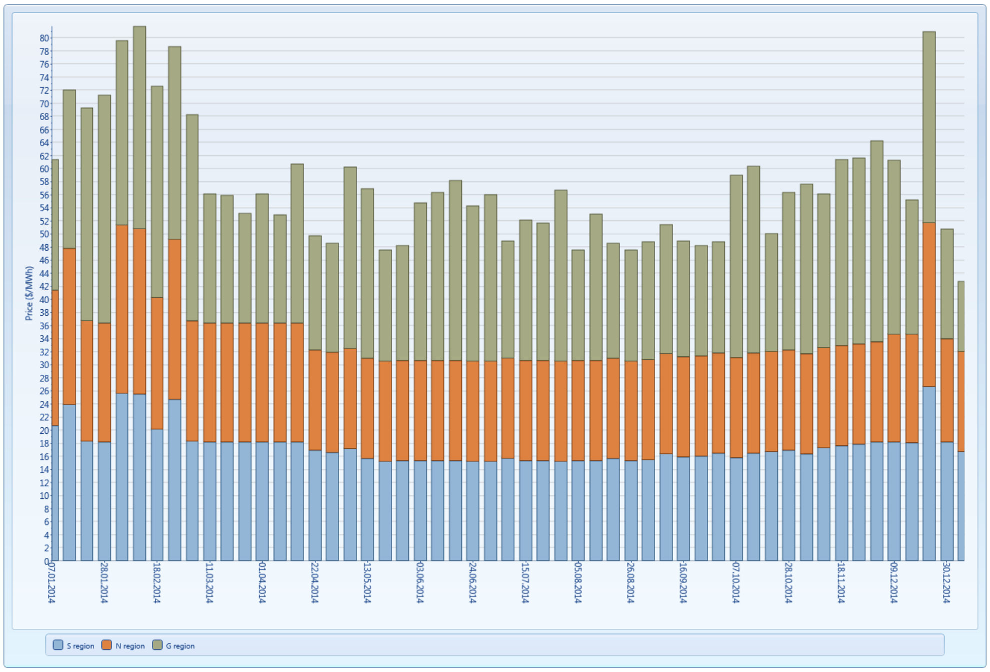

Figure 18: Calculcated prices with high inflow

4 Conclusion